

The Examiner objected to the application because it is missing an abstract of the disclosure as required by 37 CFR 1.72(b). A new abstract has been added herein.

Objections to Claims

Claims 3 and 8 are objected to because there are informalities within each claim. The subject matter of Claims 3 and 8, including the term “in the sliding direction” as suggested by the Examiner, has been imported into Claim 1, and Claims 3 and 8 have been canceled.

Rejections under 35 USC §112, second paragraph

Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter that applicants regard as the invention.

Regarding Claim 1, in view of the preamble of independent Claim 1 and those of the dependent claims, the Examiner asserts that it is unclear whether applicants are claiming an internal combustion engine or a sliding bearing. Applicants herein amend the claim to replace “An internal combustion engine” with “A sliding bearing”.

Further regarding Claim 1, the Examiner asserts that it is unclear whether the phrases “essential elements” and “balance essentially consisting of” invoke either or both of the standard phrases “consisting of” and “consisting essentially of” in describing the composition of the sliding layer or whether they are equivalent to “comprising” language. Applicants herein amend the claim to avoid the use of “essential elements”, instead positively reciting Ag and Sn as in the proposed

amendments. Applicants further replace “essentially consisting of” with the commonly accepted standard phrase “consisting essentially of”.

The Examiner asserts that it is unclear whether the phrase “as essential elements” refers to Ag and Sn or to Ag, Sn, and Cu. Applicants herein delete reference to “as essential elements” and have clarified the referenced elements.

In Claim 1, it is unclear what is the antecedent basis of the phrase “the sliding surface.” Applicants herein delete reference to “the sliding surface”, and instead refer to “said roughened surface”.

In Claim 1, the Examiner asserts that it is unclear what is the antecedent basis of the phrase “these elements.” Applicants herein amend the claim to avoid the use of “these elements”, instead positively reciting Ag and Sn.

In Claim 1, the Examiner asserts that it is unclear what is the antecedent basis of the phrase “these elements.” As above, Applicants herein amend the claim to avoid the use of “these elements”, instead positively reciting Ag and Sn.

In Claim 1, the Examiner asserts that it is unclear what is meant by the phrase “eutectic of Ag and Sn or Cu and these elements.” Applicants herein amend the claim to avoid the use of the term “these elements”, instead positively reciting Ag and Sn, and positively reciting that the eutectic may be of Ag and Sn, or of Ag, Sn and Cu.

In Claim 1, the Examiner asserts that it is unclear what is the antecedent basis of the phrase “sliding layer.” Applicants herein amend the claim to refer to the affirmatively claimed roughened surface.

According to the Examiner, it is unclear with respect to what baseline measure a layer is to be “concentrated.” Applicants herein amend the claim to affirmatively recite that “one of: said Ag

and Sn, a hexagonal compound of Ag and Sn, a hexagonal compound of Cu and Ag and Sn, or a eutectic of Ag and Sn or of Cu and Ag and Sn; is present in a higher concentration in a portion of a sub-layer of the alloy than in the alloy nearest said backing metal.” Applicants submit that this amendment clarifies that which is claimed.

Regarding Claims 2-10, it is unclear what is being claimed because Claim 1 purportedly claims an internal combustion engine, whereas the dependent claims refer to a sliding bearing for an internal combustion engine. Applicants respectfully submit that the above amendment to Claim 1 with respect to “An internal combustion engine” will obviate this rejection.

According to the Examiner, it appears that the word “contains” in line 2 of Claim 2 should be replaced with the phrase “further comprises.” Applicants herein amend Claim 2 to comply with the suggestion.

According to the Examiner, in Claim 2 it is unclear what is the antecedent basis of the phrase “sliding surface.” Applicants herein delete reference to “the sliding surface”, and instead refer to “said roughened surface”.

According to the Examiner, in Claim 2 it is unclear what is the antecedent basis of the phrases “these elements” and “these elements with one another.” Applicants have amended Claim 2 to more clearly recite that which the inventor considers the invention.

In Claim 2, the Examiner asserts that it is unclear what is meant by the phrase “a eutectic of said essential elements and additive elements or Cu and these elements.” Applicants herein amend the claim to avoid the use of “these elements”, instead positively reciting Ag and Sn as the essential elements and positively reciting that the eutectic may be of Ag and Sn and at least one additive element, or of Ag, Sn, Cu, and at least one additive element.

The Examiner asserts that in Claim 2 it is unclear what is meant by the phrase “sliding layer.”

Applicants herein amend the claim to refer to the antecedently referenced roughened surface.

According to the Examiner, in Claim 2 it is unclear with respect to what baseline measure a layer is to be “concentrated.” Applicants have amended Claim 1 to affirmatively recite that “one of: said Ag and Sn, a hexagonal compound of Ag and Sn, a hexagonal compound of Cu and Ag and Sn, or a eutectic of Ag and Sn or of Cu and Ag and Sn; is present in a higher concentration in a portion of a sub-layer of the alloy than in the alloy nearest said backing metal.” Because Claim 2 is dependent on Claim 1 and necessarily includes its limitations, Applicants submit that this amendment clarifies that which is claimed.

In Claim 2, the Examiner asserts that it is unclear whether the solid-dissolved material lacking secondary phase in the vicinity of the sliding surface and the concentrated layer or other sublayer possibilities of at least a portion of the sliding layer are independent of those described in Claim 1, from which Claim 2 depends. Applicants have amended Claim 2 to recite “said one of: said Ag and Sn, said hexagonal compound, or said eutectic; present in a higher concentration in a portion of the sub-layer further comprises said at least one additive element.” Applicants submit that this claim now clearly recites the claimed invention.

In Claims 3 and 8, the Examiner asserts that it is unclear whether what is claimed is that the roughened surface is formed by forming grooves or that the roughened surface comprises a groove structure. Per the Examiner’s suggestion, Applicants have amended the limitation of Claims 3 and 8 to read “formed of grooves”, imported this limitation into Claim 1, and subsequently canceled Claims 3 and 8, which Applicants submit obviates this rejection.

In Claim 7, the Examiner asserts that it is unclear as to the antecedent basis of the phrase “said coating layer.” Applicants have amended Claim 1, from which Claim 7 depends, to positively recite the coating layer.

Rejections under 35 U.S.C. §102

Claims 1, 4, 6, and 7 are rejected under 35 U.S.C. 102(e) as being anticipated by commonly assigned U.S. Patent No. 6,025,081 to Ohshiro et al., and are rejected under 35 U.S.C. 102(b) as being anticipated by commonly assigned WO 97/15695 to Ohshiro et al., which corresponds to US Patent No. 6,025,081. The Examiner asserts that the 6,025,081 patent teaches sliding bearings for internal combustion engines comprised of metal backing layers coated with copper alloy materials of the claimed compositions.

Applicants note that the Examiner has indicated that the subject matter of those claims not rejected over prior art references was not considered to be anticipated or rendered obvious by the reviewed prior art, and specifically that bearings having the claimed qualities and having grooves extending in the sliding direction were not disclosed. Applicants have imported this limitation into Claim 1. Therefore, Applicants submit that Claim 1 distinguishes from the cited references, and therefore that the claim should be allowable. Further, because Claims 2, 4-7, 9, and 10 are dependent from Claim 1 and necessarily include its limitation, Applicants submit that these claims are allowable as well.

Claims 1, 4, 6, and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by commonly assigned WO 97/15695 to Ohshiro et al., which corresponds to commonly assigned US 6,025,081, cited in the above rejection. As in the rejection above, the limitation of the grooves has been

imported into Claim 1, and therefore Claim 1 and all claims dependent on it should be patentable over the cited references.

Rejections under 35 U.S.C. 103

Claims 2 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6,025,081 in view of EP 795693 to Ohshiro. Furthermore, Claims 2 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 97/15695 in view of EP 795693. The Examiner sets forth the identical arguments with both of these rejections, since US 6,025,081 and WO 97/15695 are family members.

Applicants note again that the Examiner has indicated that the subject matter of those claims not rejected over prior art references was not considered to be anticipated or rendered obvious by the reviewed prior art, and specifically that bearings having the claimed qualities and having grooves extending in the sliding direction were not disclosed. Applicants have imported this limitation into Claim 1. Therefore, Applicants submit that Claim 1 distinguishes from the cited references, and therefore that the claim should be allowable. Further, because Claims 2, 4-7, 9, and 10 are dependent from Claim 1 and necessarily include its limitations, Applicants submit that these claims are in condition for allowance as well.

For at least the above reasons, Applicants respectfully submit that the rejections of record have been overcome, and that the rejection should be withdrawn and the claims passed to issue.

Should the Examiner deem that any further action by Applicants would be desirable to place the application in condition for allowance, the Examiner is encouraged to telephone Applicants' undersigned attorney.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

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Attachments: Version with markings to show changes made

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Please amend the claims as follows:

1. (Amended) ~~An internal combustion engine~~ A sliding bearing for supporting an opposing shaft movable in a sliding direction against said sliding bearing, characterized in that:

a copper alloy ~~contains~~ containing from 0.1 to 2% by weight of Ag and from 1 to 10% by weight of Sn ~~as the essential elements~~, the balance essentially of the alloy consisting essentially of Cu, is bonded to a backing metal, and has on its side opposite to the backing metal a roughened surface of approximately 0.5 to approximately 10 μm of roughness (Rz);

~~the said~~ roughened surface is coated with a coating layer comprising at least one thermo-setting resin, which is selected from the group consisting of polyimide resin, polyamide-imide resin, epoxy resin and phenol resin, and which contains from 55 to 95% by weight of MoS₂, and wherein said roughened surface is formed of grooves extending in the sliding direction;

~~Ag and Sn are solid-dissolved in the Cu matrix of the copper alloy in at least the vicinity of the sliding surface~~ said roughened surface where essentially no secondary phase of ~~these elements~~ Ag or Sn is formed;

and, ~~a concentrated layer of~~ one of:

~~said Ag and Sn,~~

~~a hexagonal compound of these Ag and Sn with one another,~~

~~a hexagonal compound of Cu and these elements Ag and Sn, or~~

~~a eutectic of Ag and Sn, or a eutectic of Cu and these elements Ag and Sn;~~

is formed as a present in a higher concentration in a portion of a sub-layer of at least a portion of the sliding layer, which portion is brought into direct contact with an opposing shaft of the alloy than in the alloy nearest said backing metal.

2. (Amended) A sliding bearing according to Claim 1, characterized in that said copper alloy contains comprises 10% by weight or less of at least one additive element selected from the group consisting of Sb, In, Al, Mg and Cd; the essential elements said Ag and Sn and the said at least one additive elements element are solid-dissolved in the Cu matrix of the copper alloy in at least the vicinity of the sliding surface said roughened surface where essentially no secondary phase of these elements Ag or Sn or said at least one additive element is formed; and wherein, a concentrated layer of said one of:

said essential Ag and Sn and additive elements,
a hexagonal compound of these elements with one another,
said a hexagonal compound of Cu and these elements, or
said a eutectic of said essential elements and additive elements or Cu and these elements;

present in a higher concentration in a portion of the is formed as a sub-layer of at least a portion of the sliding layer, which portion is brought into direct contact with an opposing shaft further comprises said at least one additive element.

11. (New) A sliding bearing according to claim 1, wherein said Ag and Sn, said hexagonal compound, or said eutectic is present in a portion of the sub-layer in a concentration that is at least 1.3 times higher than in the alloy nearest said backing metal.

12. (New) A sliding bearing according to claim 2, wherein said Ag and Sn and said at least one additive element, said hexagonal compound, or said eutectic is present in a portion of the sublayer in a concentration that is at least 1.3 times higher than in the alloy nearest said backing metal.

ABSTRACT OF THE DISCLOSURE

B1 A sliding bearing for an internal combustion engine including a copper-based bearing alloy including silver and tin upon which an overlay is applied. The overlay comprises resin and MoS₂, and the adherence of the overlay to the alloy is enhanced by a roughened alloy surface formed of grooves extending in the sliding direction.
